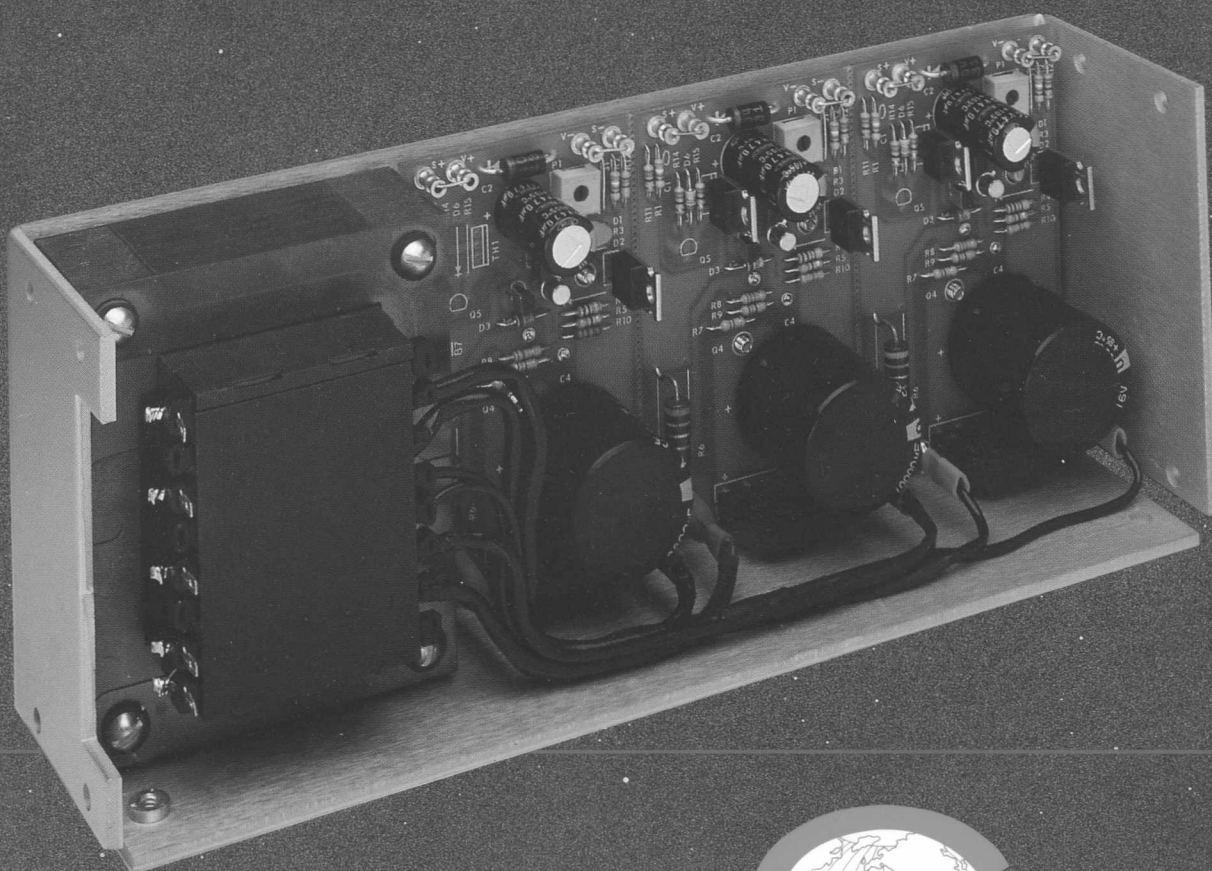


HAMMOND
MANUFACTURING™



DC LINEAR
POWER SUPPLIES



Catalog 5LP87•1

Hammond Manufacturing

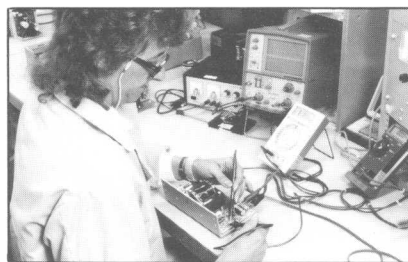
Hammond Manufacturing Company Limited has been producing high quality products serving the electrical and electronic markets since 1917. Now operating 15 plants throughout North America, the Hammond group of companies has grown to include four major product areas: transformers, cabinetry, wiring devices and power supplies.

Power Supply Division

The GLOBAL Series linear power supplies described in this catalog are supplemented by a full range of standard open frame switchers and a wide variety of custom designed and manufactured power supplies, all produced in our modern facility. Product quality and reliability are key objectives of the Hammond team, beginning with initial design, through control of component parts, tight control of the manufacturing processes, and rigorous burn-in and testing procedures. Significant investments have been made in plant, equipment and people over the past 5 years resulting in our present capabilities:

- modern air-conditioned production facility
- CAD system for magnetics designs
- electrostatic discharge (ESD) protection throughout production and packing areas
- automated test equipment allowing full data logging
- computer integrated manufacturing (CIM) system for control from incoming components to finished power supplies
- environmental test equipment providing temperature, humidity and vibration cycling under varying load conditions as well as thermal shock

The Hammond Power Supply Division is continuing to focus on providing products designed with proven technologies and manufactured to meet the highest customer requirements of quality and reliability, all with a commitment to deliver on time. The GLOBAL Series linear power supplies is typical of the results achieved by dedication to these goals.



Features

Worldwide AC Input Capabilities

100/120/220/240 VAC.

Compliance with International Safety Standards

UL, CSA, VDE, IEC.

UL Recognized

CSA Certified

TUV Certified to VDE 0806

Certified to IEC 380, 435

VDE Transformer Construction

CAD Optimized Magnetics

Through the development of precise and detailed transformer design programs, Global Series transformers have been optimized to provide maximum performance and reliability through low temperature rise.

Isolated Outputs

Outputs of all Global Series power supplies are fully isolated and independently regulated.

PCB-Mounted Capacitors

All Global Series power supplies employ high CV density, low ESR capacitors mounted on the printed circuit board, thereby improving producibility and reliability.

Industry Standard Packages and Mounting Centers

Remote Inhibit

Standard on series N, 3, 4, 5, 2TA-output 1. Refer to application notes on page 9.

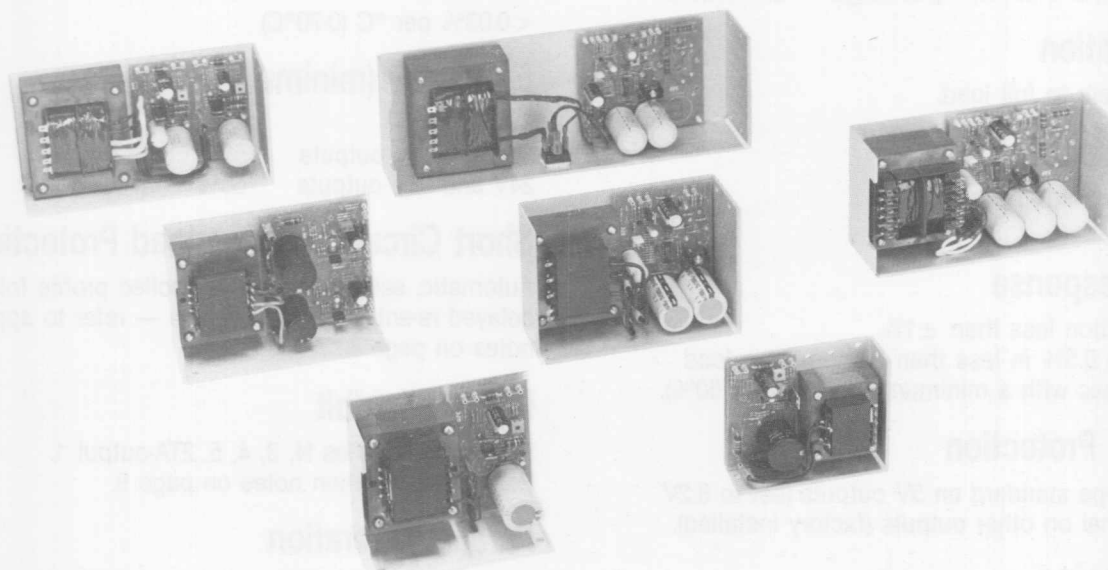
Anti-lockout Current Protection

All Global Series power supplies employ exclusive anti-lockout circuitry in the current limit/overload protection section. For complete details, refer to the application notes on page 8.

Forced Current Sharing, Parallel Operation

Many of the units in the Global Series are provided with a 'P' terminal. This allows forced current sharing of an unlimited number of units without the need for blocking or steering diodes. For complete details, refer to the application notes on page 8.

Full Two Year Warranty



SPECIFICATIONS

Safety Specifications

Global Series power supplies meet the safety requirements of the world's most respected safety agencies. All models meet or exceed the following safety standards:

Leakage Current

Line to Ground (max) 0.05 mA

Creepage Distance

Live Parts to Dead Metal (min) 9.0 mm (.345 in)

Dielectric Withstand Voltage (min)

Input to Ground 1250 VRMS
Input to Outputs 3750 VRMS
Outputs to Ground 700 VDC

UL Recognized

UL File Number E79455.

CSA Certified

CSA File Number LR53007.

TUV Certified to VDE 0806

Certified to IEC 380, 435

Electrical Specifications

AC Input

100/120/220/240 VAC + 10% - 13%
47-63Hz

DC Output

Refer to Tables
Adjustment Range $\pm 5\%$ minimum.

Line Regulation

$\pm .005\%$ maximum over full input range — all models.

Load Regulation

$\pm .015\%$ from zero to full load.

Output Ripple

<1mV pp typical, 3mV pp max.
(DC to 100 kHz).

Transient Response

Maximum deviation less than $\pm 1\%$.
Recovers within 0.5% in less than 20 μ sec (for a load change at 1A/ μ sec with a minimum fixed load of 50%).

Overvoltage Protection

SCR crowbar type standard on 5V outputs (set to 6.2V $\pm 8\%$) — optional on other outputs (factory installed).

Remote Sensing

Standard on all models.

Stability

$\pm 0.3\%$ for 24 hours after warm-up.

Temperature

Operating: 0-70°C (derate linearly above 50°C to 50% load at 70°C).
Storage: -40°C to +85°C.

Temperature Coefficient

<0.03% per °C (0-70°C)

Efficiency (minimum)

| | |
|---------------------|-----|
| 5V outputs | 45% |
| 12V and 15V outputs | 55% |
| 24V and 28V outputs | 60% |

Short Circuit and Overload Protection

Automatic, self-recovering, controlled profile foldback and delayed re-entrant foldback type — refer to application notes on page 8.

Remote Inhibit

Standard on series N, 3, 4, 5, 2TA-output 1.
Refer to application notes on page 9.

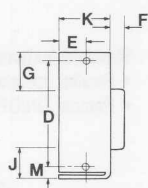
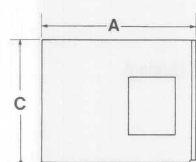
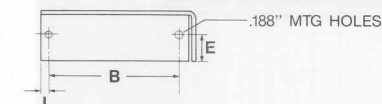
Parallel Operation

Forced current sharing — refer to application notes on page 8.

GHOE 1 Series

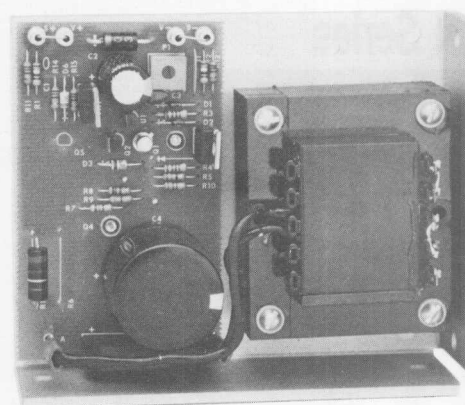
| Catalog No. | | VOLTS | AMPS |
|-------------|--------------|-------|------|
| Without OVP | With OVP | | |
| GHOE 1-5* | GHOE 1-5 | 5 | 3.0 |
| GHOE 1-12 | GHOE 1-12OVP | 12 | 1.7 |
| GHOE 1-15 | GHOE 1-15OVP | 15 | 1.5 |
| GHOE 1-24 | GHOE 1-24OVP | 24 | 1.2 |
| GHOE 1-28 | GHOE 1-28OVP | 28 | 1.0 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs



Overall Chassis Size — 4.87" x 4.00" x 1.62"

| | Inches | mm |
|---|--------|--------|
| A | 4.87 | 123.70 |
| B | 4.125 | 104.78 |
| C | 4.00 | 101.60 |
| D | 3.375 | 85.73 |
| E | .875 | 22.23 |
| F | .45 | 11.43 |
| G | 1.25 | 31.75 |
| J | .95 | 24.13 |
| K | 1.62 | 41.15 |
| L | .25 | 6.35 |
| M | .375 | 9.53 |

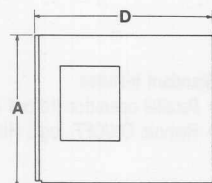
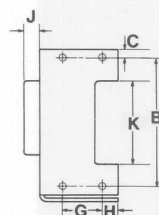
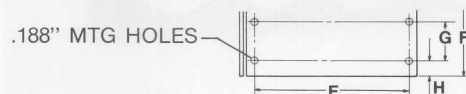


IEC 380.435

GHOE 2 Series

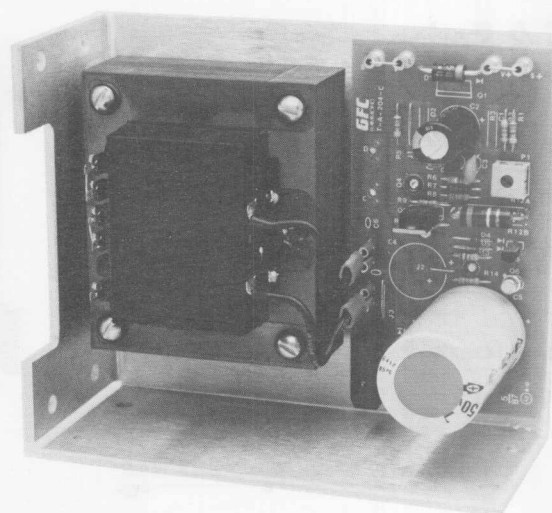
| Catalog No. | | VOLTS | AMPS |
|-------------|--------------|-------|------|
| Without OVP | With OVP | | |
| GHOE 2-5* | GHOE 2-5 | 5 | 6.0 |
| GHOE 2-12 | GHOE 2-12OVP | 12 | 3.4 |
| GHOE 2-15 | GHOE 2-15OVP | 15 | 3.0 |
| GHOE 2-24 | GHOE 2-24OVP | 24 | 2.4 |
| GHOE 2-28 | GHOE 2-28OVP | 28 | 2.0 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs



Overall Chassis Size — 4.88" x 5.63" x 2.50"

| | Inches | mm |
|---|--------|--------|
| A | 4.88 | 123.95 |
| B | 4.125 | 104.78 |
| C | .25 | 6.35 |
| D | 5.63 | 143.00 |
| E | 4.875 | 123.83 |
| F | 2.50 | 63.50 |
| G | 1.25 | 31.75 |
| H | .50 | 12.70 |
| J | .45 | 11.42 |
| K | 2.69 | 68.33 |



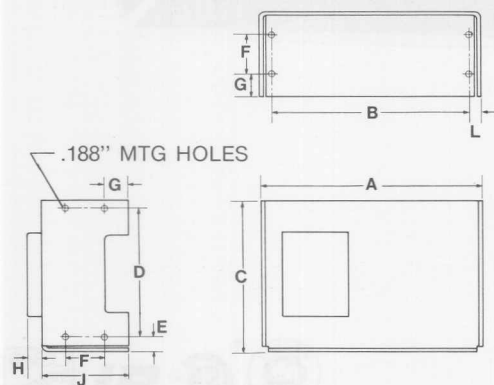
IEC 380.435

SINGLE OUTPUT

GHOE N Series

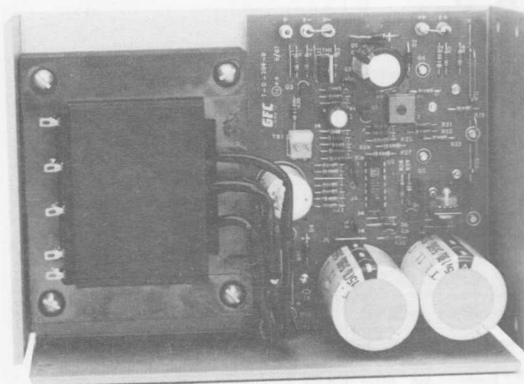
| Catalog No. | | VOLTS | AMPS |
|-------------|--------------|-------|------|
| Without OVP | With OVP | | |
| GHOE N-5* | GHOE N-5 | 5 | 9.0 |
| GHOE N-12 | GHOE N-120VP | 12 | 5.1 |
| GHOE N-15 | GHOE N-150VP | 15 | 4.5 |
| GHOE N-24 | GHOE N-240VP | 24 | 3.6 |
| GHOE N-28 | GHOE N-280VP | 28 | 3.0 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs



Overall Chassis Size — 7.00" x 4.87" x 2.75"

| | Inches | mm |
|---|--------|--------|
| A | 7.00 | 177.80 |
| B | 6.25 | 158.75 |
| C | 4.87 | 123.70 |
| D | 4.125 | 104.78 |
| E | .50 | 12.70 |
| F | 1.25 | 31.75 |
| G | .75 | 19.05 |
| H | .45 | 11.43 |
| J | 2.75 | 69.85 |
| L | .375 | 9.53 |



Standard features

- Parallel operation (forced current sharing)
- Remote ON/OFF, logic HI/LO

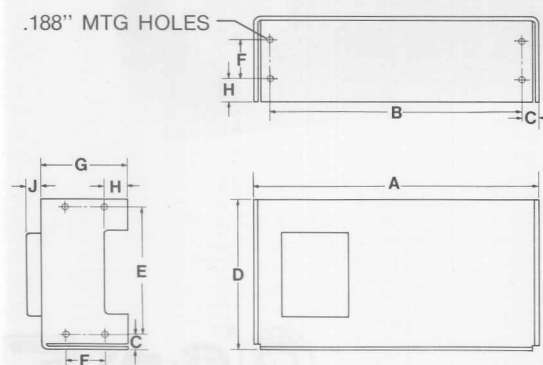


IEC 380-435

GHOE 3 Series

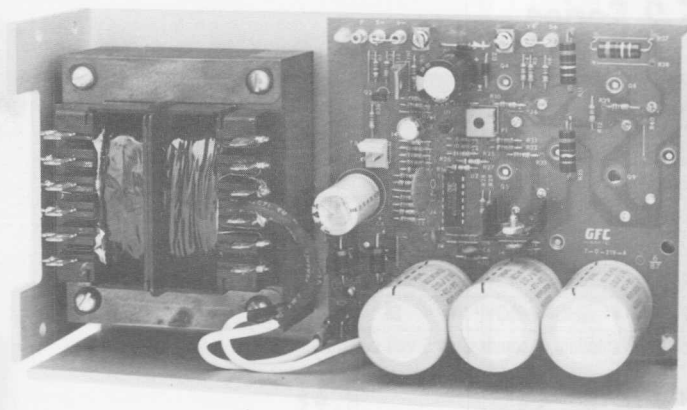
| Catalog No. | | VOLTS | AMPS |
|-------------|--------------|-------|------|
| Without OVP | With OVP | | |
| GHOE 3-5* | GHOE 3-5 | 5 | 12.0 |
| GHOE 3-12 | GHOE 3-120VP | 12 | 7.0 |
| GHOE 3-15 | GHOE 3-150VP | 15 | 6.2 |
| GHOE 3-24 | GHOE 3-240VP | 24 | 4.8 |
| GHOE 3-28 | GHOE 3-280VP | 28 | 4.0 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs



Overall Chassis Size — 9.00" x 4.88" x 2.75"

| | Inches | mm |
|---|--------|--------|
| A | 9.00 | 228.60 |
| B | 8.00 | 203.20 |
| C | .50 | 12.70 |
| D | 4.88 | 123.95 |
| E | 4.125 | 104.78 |
| F | 1.25 | 31.75 |
| G | 2.75 | 69.85 |
| H | .75 | 19.05 |
| J | .45 | 11.43 |



Standard features

- Parallel operation (forced current sharing)
- Remote ON/OFF, logic HI/LO

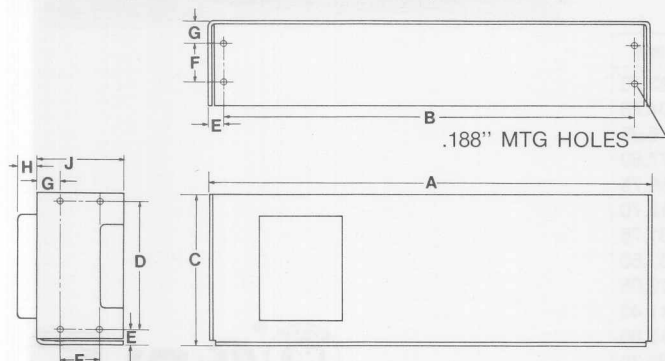
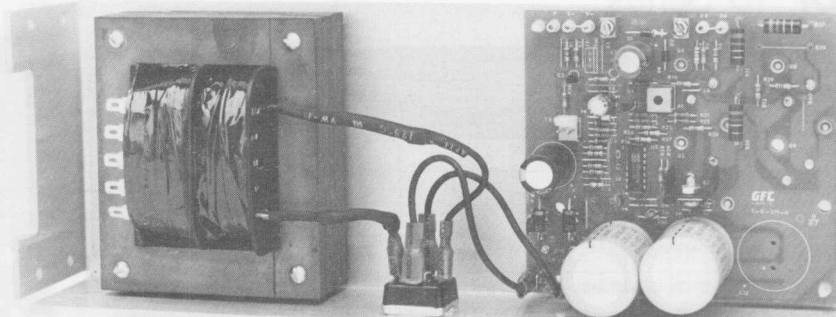


IEC 380-435

GHOE 4 Series

| Catalog No. | | VOLTS | AMPS |
|-------------|--------------|-------|------|
| Without OVP | With OVP | | |
| GHOE 4-5* | GHOE 4-5 | 5 | 18.0 |
| GHOE 4-12 | GHOE 4-12OVP | 12 | 10.2 |
| GHOE 4-15 | GHOE 4-15OVP | 15 | 9.0 |
| GHOE 4-24 | GHOE 4-24OVP | 24 | 7.2 |
| GHOE 4-28 | GHOE 4-28OVP | 28 | 6.0 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs



| | Inches | mm |
|---|--------|--------|
| A | 14.00 | 355.60 |
| B | 13.00 | 330.20 |
| C | 4.88 | 123.95 |
| D | 4.125 | 104.78 |
| E | .50 | 12.70 |
| F | 1.25 | 31.75 |
| G | .75 | 19.05 |
| H | .65 | 16.51 |
| J | 2.75 | 69.85 |

Standard features

- Parallel operation (forced current sharing)
- Remote ON/OFF, logic HI/LO

Overall Chassis Size — 14.00" x 4.88" x 2.75"

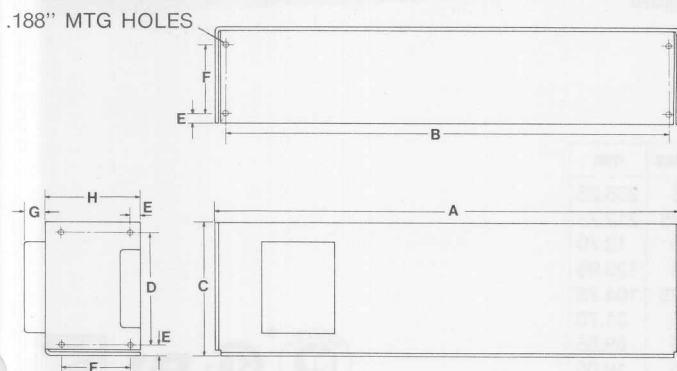
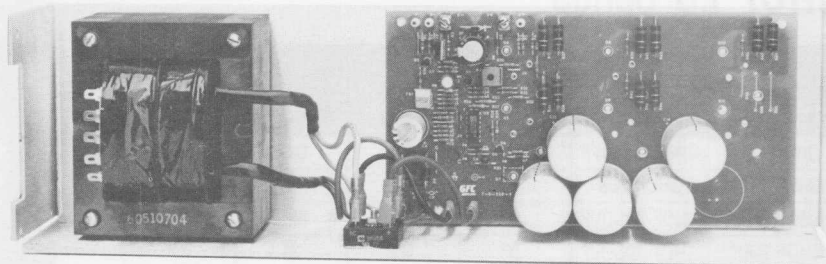


IEC 380 435

GHOE 5 Series

| Catalog No. | | VOLTS | AMPS |
|-------------|--------------|-------|------|
| Without OVP | With OVP | | |
| GHOE 5-5* | GHOE 5-5 | 5 | 25.0 |
| GHOE 5-12 | GHOE 5-12OVP | 12 | 16.0 |
| GHOE 5-15 | GHOE 5-15OVP | 15 | 15.0 |
| GHOE 5-24 | GHOE 5-24OVP | 24 | 12.0 |
| GHOE 5-28 | GHOE 5-28OVP | 28 | 10.0 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs



| | Inches | mm |
|---|--------|--------|
| A | 16.75 | 425.45 |
| B | 16.00 | 406.40 |
| C | 4.88 | 123.95 |
| D | 4.125 | 104.78 |
| E | .375 | 9.53 |
| F | 2.50 | 63.50 |
| G | .75 | 19.05 |
| H | 3.50 | 88.90 |

Standard features

- Parallel operation (forced current sharing)
- Remote ON/OFF, logic HI/LO

Overall Chassis Size — 16.75" x 4.88" x 3.50"



IEC 380 435

DUAL OUTPUT

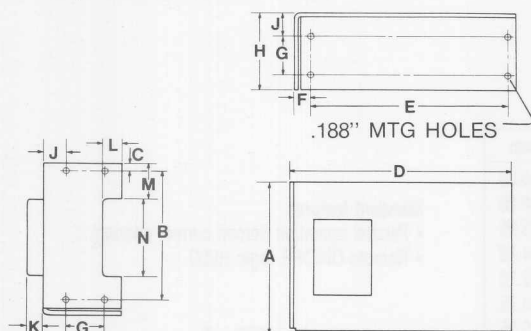
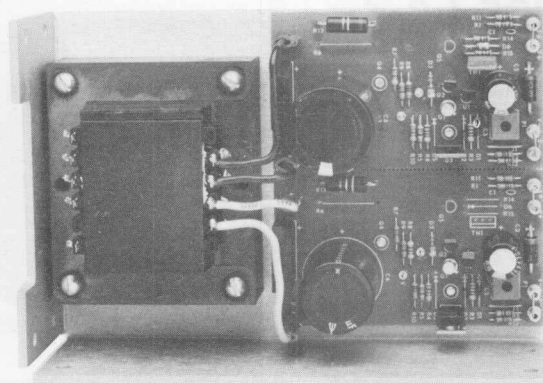
GHOE 1D Series

| Catalog No. | | Output1 | | Output2 | |
|-------------|-------------|---------|------|---------|------|
| Without OVP | With OVP | VOLTS | AMPS | VOLTS | AMPS |
| GHOE 1DA | GHOE 1DAOVP | 12-15 | 1.5 | 12-15 | 1.5 |
| GHOE 1DB* | GHOE 1DB | 5 | 3.0 | 5 | 3.0 |
| GHOE 1DC* | GHOE 1DCOVP | 5 | 3.0 | 12-15 | 1.5 |
| GHOE 1DD* | GHOE 1DDOVP | 5 | 3.0 | 24 | 0.4 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs

NOTE: When specifying OVP on units with adjustable 12-15 Volt outputs, specify OVP voltage required.

Example: GHOE 1DC OVP-12 or GHOE 1DC OVP-15



| | Inches | mm |
|---|--------|--------|
| A | 4.87 | 123.70 |
| B | 4.125 | 104.78 |
| C | .25 | 6.35 |
| D | 7.00 | 177.80 |
| E | 6.25 | 158.75 |
| F | .50 | 12.70 |
| G | 1.25 | 31.75 |
| H | 2.50 | 63.50 |
| J | .75 | 19.05 |
| K | .45 | 11.43 |
| L | .63 | 16.00 |
| M | 1.13 | 28.70 |
| N | 2.50 | 63.50 |

Overall Chassis Size — 4.87" x 7.00" x 2.50"



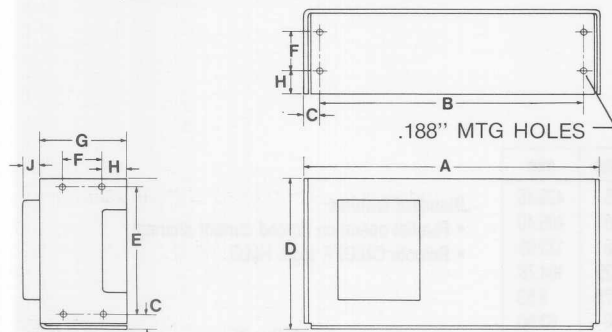
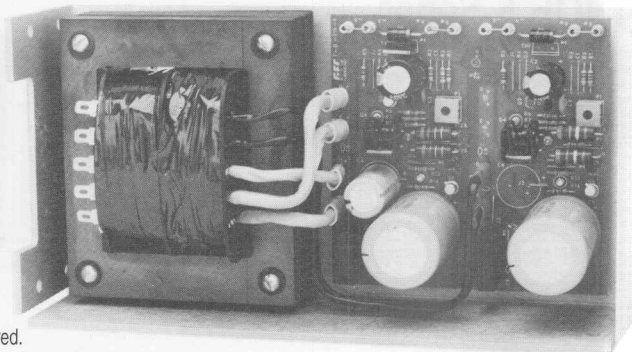
GHOE 2D Series

| Catalog No. | | Output1 | | Output2 | |
|-------------|-------------|---------|------|---------|------|
| Without OVP | With OVP | VOLTS | AMPS | VOLTS | AMPS |
| GHOE 2DA | GHOE 2DAOVP | 12-15 | 3.0 | 12-15 | 3.0 |
| GHOE 2DB* | GHOE 2DB | 5 | 6.0 | 5 | 6.0 |
| GHOE 2DC* | GHOE 2DCOVP | 5 | 6.0 | 12-15 | 3.0 |
| GHOE 2DD* | GHOE 2DDOVP | 5 | 6.0 | 24 | 2.3 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs

NOTE: When specifying OVP on units with adjustable 12-15 Volt outputs, specify OVP voltage required.

Example: GHOE 2DC OVP-12 or GHOE 2DC OVP-15



| | Inches | mm |
|---|--------|--------|
| A | 9.38 | 238.25 |
| B | 8.375 | 212.73 |
| C | .50 | 12.70 |
| D | 4.88 | 123.95 |
| E | 4.125 | 104.78 |
| F | 1.25 | 31.75 |
| G | 2.75 | 69.85 |
| H | .75 | 19.05 |
| J | .45 | 11.43 |

Overall Chassis Size — 9.38" x 4.88" x 2.750"



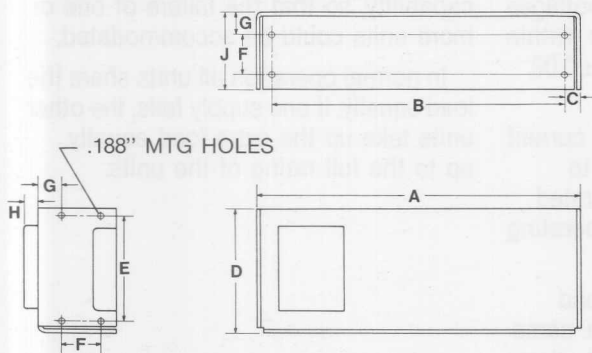
GHDD Series — Isolated Outputs

| Catalog No. | | Output1 | | Output2 | | Output3 | |
|-------------|-------------|---------|------|---------|------|---------|------|
| Without OVP | With OVP | VOLTS | AMPS | VOLTS | AMPS | VOLTS | AMPS |
| GHDD 100* | GHDD 100OVP | 24 | 2.0 | 5 | 1.5 | 5 | 0.5 |
| GHDD 101* | GHDD 101OVP | 12-15 | 1.0 | 5 | 3.0 | 12-15 | 1.0 |
| GHDD 102* | GHDD 102OVP | 24 | 2.0 | 5 | 1.0 | 12-15 | 0.7 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs

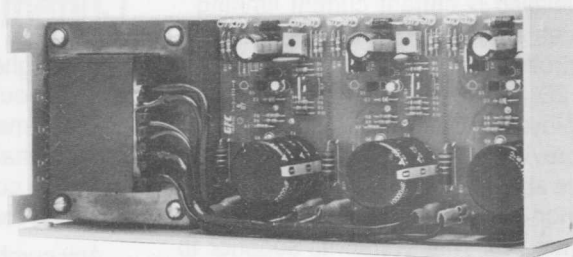
NOTE: When specifying OVP on units with adjustable 12-15 Volt outputs, specify OVP voltage required.

Example: GHDD 101 OVP-12 or GHDD 101 OVP-15



| | Inches | mm |
|---|--------|--------|
| A | 10.25 | 260.35 |
| B | 9.25 | 234.95 |
| C | .50 | 12.70 |
| D | 4.00 | 101.60 |
| E | 3.375 | 85.73 |
| F | 1.25 | 31.75 |
| G | .75 | 19.05 |
| H | .45 | 11.43 |
| J | 2.50 | 63.50 |

Overall Chassis Size — 10.25" x 4.00" x 2.50".



IEC 380 435

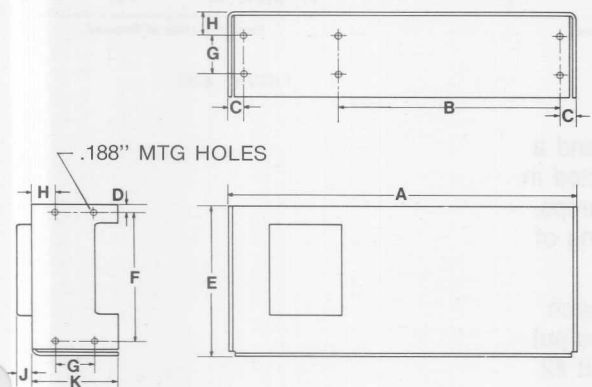
GHOV 2TA — Isolated Outputs

| Catalog No. | | Output1 | | Output2 | | Output3 | |
|-------------|-------------|---------|------|---------|------|---------|------|
| Without OVP | With OVP | VOLTS | AMPS | VOLTS | AMPS | VOLTS | AMPS |
| GHOV 2TA* | GHOV 2TAOVP | 5 | 8.0 | 12-15 | 1.5 | 12-15 | 1.5 |

*OVP (Overvoltage Protection) is standard on 5 Volt outputs

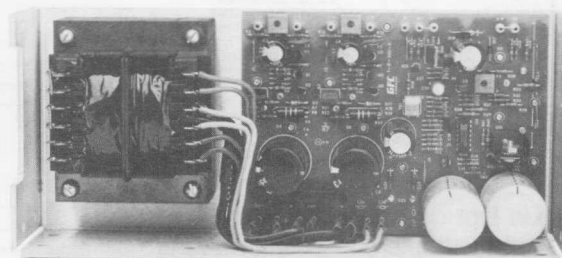
NOTE: When specifying OVP on units with adjustable 12-15 Volt outputs, specify OVP voltage required.

Example: GHOV 2TA OVP-12 or GHOV 2TA OVP-15



| | Inches | mm |
|---|--------|--------|
| A | 11.00 | 279.40 |
| B | 7.00 | 177.80 |
| C | .50 | 12.70 |
| D | .25 | 6.35 |
| E | 4.88 | 123.95 |
| F | 4.125 | 104.78 |
| G | 1.25 | 31.75 |
| H | .75 | 19.05 |
| J | .45 | 11.43 |
| K | 2.75 | 69.85 |

Overall Chassis Size — 11.00" x 4.88" x 2.75".



Standard features

- Parallel operation (forced current sharing) on output 1.
- Remote ON/OFF, logic HI/LO.

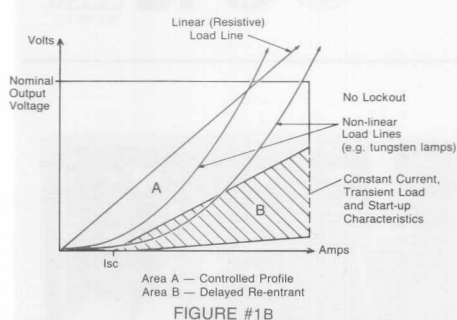
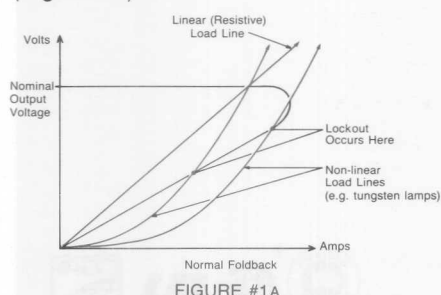


IEC 380 435

APPLICATION NOTES

1. Current Limiting

Delayed re-entrant current limiting (Series N, 3, 4, 5, 2TA-output 1) and controlled profile foldback (Series 1, 2, 1D, 2D, DD, 2TA-outputs 2 and 3) are employed in the current limit section to provide reliable foldback protection, while at the same time preventing lockout on non-linear or cross-connected loads (Figure 1B). This system is superior to a normal foldback circuit, as it applies to large inrush conditions (e.g. tungsten lamp load) or transient load conditions. (Figure 1A).



When first switched 'ON' (or under transient load), the current limit reverts to a constant current limit characteristic (area B), allowing the input capacitor and non-linear loads to be fully established without the lockout problems often encountered with the conventional foldback characteristic. After a short delay, the characteristic returns to the re-entrant mode (area A), preventing excessive dissipation for overload or short circuit conditions.

For high power units (Series N, 3, 4, 5, 2TA-output 1) operation in areas A and B is permitted during start-up. For lower power units (Series 1, 2, 1D, 2D, DD, 2TA-outputs 2 and 3) operation in area A is permitted. These increased operating areas significantly reduce lockout problems.

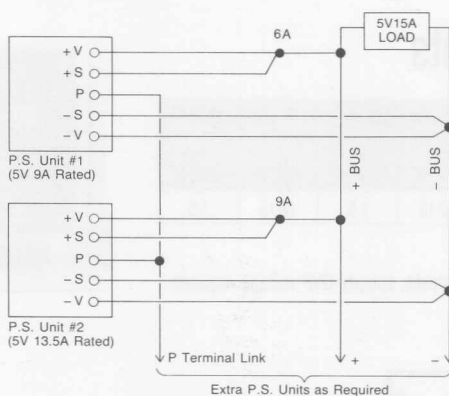
2. Forced Current Sharing

The higher power units (Series N, 3, 4, 5, 2TA-output 1) are provided with a terminal marked 'P', which forces proportional current sharing when units are connected in parallel to a common load.

Any number of units may be connected in parallel, providing the output voltages have been set to the same value (within the "capture voltage range" of ± 0.02 volts).

Units need not have the same current ratings, but will be constrained to operate at equal percentage of rated outputs, thus ensuring similar operating temperatures and long life.

The proportional sharing of load current by dissimilar outputs (i.e. same voltage, different current ratings) allows direct summation of total system power capability without derating or reduction in system MTBF due to thermal imbalances.



In Figure 2A above, a 5V 9A and a 5V 13.5A unit have been connected in parallel to supply a load of 15 amps, i.e. 66% of the total current rating of the two units.

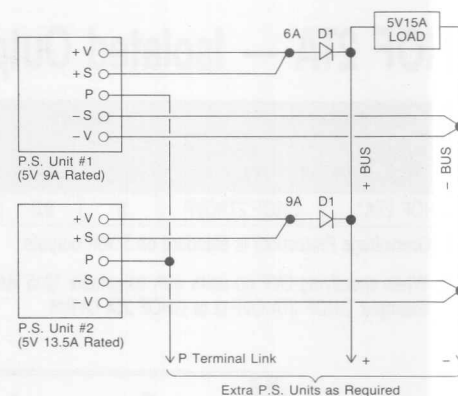
With the 'P' terminal linked, each unit provides 66% of its rated output i.e. 6A for unit #1 and 9A for unit #2. Diodes D1 are only needed if parallel redundant operation is required, as shown in Figure 2B.

3. Parallel Redundant Operation

For parallel redundant operation any number of units may be operated in parallel with isolating diodes D1 as shown in Figure 2B.

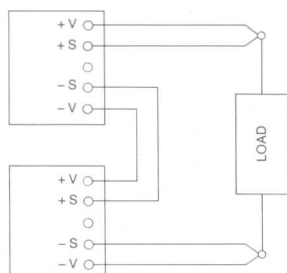
In each system, the current rating of all units would normally be the same and the load current be lower than the total capability, so that the failure of one or more units could be accommodated.

In normal operation all units share the load equally. If one supply fails, the other units take up the extra load equally, up to the full rating of the units.

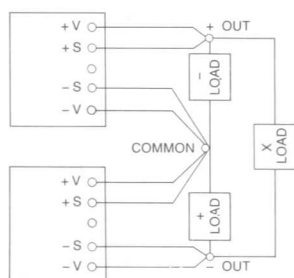


4. Series Operation

Higher power units (Series N, 3, 4, 5, 2TA-output 1) can be operated directly in series, to provide higher voltages or bipolar (positive and negative) outputs. (see Figure 3)



Series Operation



Bipolar Operation

FIGURE #3

If the load in the series connection, or cross-coupled load (X-load) in the bipolar connection, exceeds the short circuit current rating, lockout may occur after a transient overload. Correct operation will be re-established by recycling the input.

5. Remote Voltage Sensing

All units except GHOF 2TA-outputs 2 and 3 are provided with remote voltage sensing, so that voltage may be regulated at a point in the external load where most critical.

The point of regulation is connected to the remote sensing terminals marked +S and -S using a light weight twisted pair (these wires carry only a few milliamps).

The voltage drop in the power leads should not exceed 500mV total between the power supply and the point of regulation. (see Figure 4)

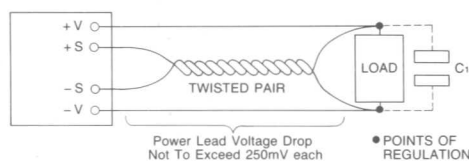


FIGURE #4

If long leads are used, local decoupling at the load is recommended (C1) to improve transient response. (C1 = >200μF/Amp)

Should a voltage sense line go open circuit, the point of regulation is transferred back to the supply terminals.

Open circuit power leads or short circuit sense leads will cause the supply to shut down without damage.

6. Overvoltage Protection (OVP)

SCR crowbar OVP is standard on all 5V outputs. The trip voltage is factory set to 6.2V ±8% which is above the adjustment range of the supply.

Testing may be carried out by applying a current-limited external supply to the output terminals.

The OVP circuit senses the voltage at the power output terminals, and the trip point may be exceeded if excessive cable drops are allowed when using remote sense.

OVP modules are available for protection of other output voltages. These are fitted at the factory.

7. Remote Inhibit

Higher power units (Series N, 3, 4, 5, 2TA-output 1) are provided with remote inhibit inputs.

The power supply may be turned 'OFF' by the application of a 2V signal from 2K Ω to pin B or by pulling pin A low (10mA current).

Inhibit signals are with respect to the common negative output sense line (-S).

2 Year Warranty

Hammond Manufacturing will repair or replace any power supply of its manufacture that does not perform to published specifications as a result of defective materials or workmanship for a period of two years from date of purchase. No other obligations are implied or expressed. Returns must be freight prepaid.